OIPE JC73
JUL 1 2 2005
PATENT & TRADEMARK

CQC

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Bruno GHYSELEN et al.

Patent No.: 6,908,774 B2

Patent Date: June 21, 2005

For: METHOD AND APPARATUS FOR ADJUSTING THE THICKNESS OF A THIN LAYER OF SEMICONDUCTOR MATERIAL

Confirmation No.: 9075

Application No.: 10/637,078

Filing Date: August 6, 2003

Attorney Docket No.: 4717-6400

Certificate
JUL 18 2005
of Correction

REQUEST FOR CERTIFICATE OF CORRECTION UNDER 37 C.F.R. § 1.322

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Patentees hereby respectfully request the issuance of a Certificate of Correction in connection with the above-identified patent. The corrections are listed on the attached Form PTO-1050, submitted in duplicate. The corrections requested are as follows:

At column 20, line 51 (claim 1, line 6), before "adjusting the thickness of the layer" insert -- selectively --.

At column 22, line 11 (claim 18, line 7), before "sacrificial oxidation for adjusting" insert -- selective --.

Support for the above changes appear in applicants' Amendment After Allowance filed February 23, 2005, which was entered by the Examiner on May 19, 2005.

The requested corrections are for errors that appear to have been made by the Office. Therefore, no fee is believed to be due for this request. Should any fees be required, however, please charge such fees to Winston & Strawn LLP Deposit Account No. 50-1814. Please issue a Certificate of Correction in due course.

Respectfully submitted,

7-12-05
Date

Allan A. Fanucci
Allan A. Fanucci, Reg. No. 30,256

WINSTON & STRAWN LLP
Customer No. 28765

212-294-3311

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO.: 6,908,774 B2
DATED: June 21, 2005
INVENTORS: Ghyselen et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 20, line 51, before "adjusting the thickness of the layer" insert -- selectively --.
Column 22, line 11, before "sacrificial oxidation for adjusting" insert -- selective --.

Another aspect of the invention lies in the fact that thin layers are generally prepared in batches. In this aspect of the invention, a single target thickness profile is defined for all of the layers in a batch (i.e. the "target" **30** is common to all of the layers in the batch). The respective thickness adjustment specifications for each layer in the batch are then individualized in such a manner that each layer of the batch, after thickness adjustment has been performed, presents a final layer thickness profile that is as close as possible to the target profile. The thickness adjustments may be uniform, differential, or both uniform and differential, as described above.

The method as applied to batches of layers can also be applied to a batch organized as a succession of layers, in which the mean thickness of one layer in the batch is measured (**1051'**) while the thickness of the preceding layer in the same batch is being corrected (**1053'**), after the thickness of said preceding layer has itself been measured. An overall result of using a method of this type in accordance with the invention is shown in FIG. **13** which comprises three graphs **13***a*, **13***b*, and **13***c*. These three graphs represent histograms of thickness distribution amongst layers in a given batch (for simplification purposes, each batch is shown comprising three layers). Each histogram curve thus corresponds to a single layer, representing the number N of points on the surface of the layer that had a given thickness (thickness plotted along the abscissa axis, N up the ordinate axis). Each layer thus has a thickness which can typically be represented by a Gaussian curve (with the points at which thickness is determined being defined by a mesh over the surface of the layer). Vertical dotted lines represent the mean thickness of each layer.

Graph **13***a* thus shows a first distribution of thicknesses for the three layers in a batch. Each of these three layers presents a distribution of thicknesses about a respective mean thickness.

Graph **13***b* shows the same layers after treatment by sacrificial oxidation seeking to make the mean thicknesses of the layers uniform. For this purpose, a configuration was adopted in which the recipes selected for each layer were individualized, as a function of the measurements of the layer, and for the purposes of achieving a common target. This leads to the mean thicknesses of the layers in the batch to come closer together (better layer-to-layer or wafer-to-wafer uniformity).

It is also possible to consider that, a priori, the layers in each batch present similar thickness profiles, within given tolerances. This is true in particular when the layers in a given batch have previously been subjected to the same fabrication steps under the same conditions. Under such circumstances, it is possible to measure only some of the layers in the batch (or even only one layer), instead of measuring all of the layers of the batch. Depending on the result of this or these thickness measurement(s), a single recipe is deduced (automatically, or by an operator) for application to all of the layers in the batch for the purpose of correcting thickness.

Such treatment, the result of which is not shown in the figures, leads to a shift in the mean thickness values of the layers in the batch, without the values coming closer together (the shift is towards smaller values of mean thickness, because of the way thickness is corrected).

Finally, the particular thickness adjustment apparatus described above (of the RTP XE CENTURA™) merely constitutes a non-limiting example which is particularly well suited to correcting the thickness of a single layer at a time.

It is possible to implement the method of the invention using any apparatus for correcting the surface thickness of a layer. In particular, such apparatus can make it possible advantageously to correct layer thickness in selective manner.

It is recalled that the term "selective" is used herein to cover the ability to attack different regions of the surface of the layer in differential manner. By correcting the thickness of each layer in a selective and an individualized manner (which means that each layer whose thickness is to be corrected must be measured), it is possible to narrow the spread of the thickness distribution histogram for each layer of the batch, and also to move the mean thickness values of the layers closer together. This is shown by the graph **13***c*.

In all circumstances, thickness adjustment implements sacrificial oxidation.

It is thus possible, for example, to process entire batches of layers in horizontal or vertical tube ovens (where vertical tube ovens are also referred to as "bells)". Such annealing ovens are known in the state of the art. They enable entire batches of layers to be subjected to heat treatment. The layers are aligned one after another, e.g. in quartz boats provided with parallel notches for receiving the layers.

It is possible to adjust the characteristics of the heat treatment applied by the oven so as to apply selective thickness adjustment to the surface of each layer of the batch in different regions of the layer. For this purpose, action can be taken in particular on the composition of the mixture of gases inside the oven, and more precisely on the composition of the mixture of gases circulating in the various portions of the oven.

It is possible to provide that the mixture is more or less oxidizing in certain regions of the oven. This can be achieved by local flow of a specific gas mixture.

Thus, when it is desired to treat all of the layers in a batch in the same manner, all of the dispositions seeking to produce special conditions locally inside the oven are applied in the same manner to all of the layers in the batch.

It is also possible to act on the presence of hot zones inside the oven. In this case also, the presence of hot zones can be defined so as to have the same influence on all of the layers in a batch.

For example, provision can be made to ensure that the sacrificial oxidation attacks the layers more in their peripheral regions than in their central regions, which corresponds to a convex recipe.

It is possible to act on the flows of gas inside the oven, in order to obtain such hot zones.

In contrast, it is also possible to manage non-uniformities of temperature inside the oven in controlled manner so as to cause the heat treatment applied to the various layers in a batch to be different.

What is claimed is:

1. A method for adjusting the thickness of a thin semiconductor material layer which comprises:

measuring the layer to establish a thickness profile;

determining thickness adjustment specifications from the ~~measured thickness~~ profile; and

adjusting the thickness of the layer in accordance with the specifications by sacrificial oxidation. selectively

2. The method according to claim **1** wherein the thickness adjustment specifications correspond to at least one of uniform thickness modification across the layer, or differential thickness modification across the layer.

3. The method according to claim **1** wherein the thickness adjustment specifications are established to produce a layer having a constant thickness over the entire layer.

4. The method according to claim **1** which further comprises applying thickness adjustments simultaneously to the layer surface.

5. The method according to claim **1** further comprising preparing batches of layers for adjustment of layer thicknesses.

6. The method according to claim **5** further comprising performing layer thickness adjustment on the batches of layers.

7. The method according to claim **5** further comprising defining a final target thickness profile for all layers of the batch, and individualizing the respective thickness adjustment specifications for each layer of the batch so that a final layer thickness profile of each layer of the batch is as close as possible to the final target thickness profile.

8. The method according to claim **5** further comprising defining a single target thickness profile for all of the layers of the batch, and utilizing the same thickness adjustment specification for all of the layers of the batch, wherein the specification is a function of at least one thickness measurement performed on a layer of the batch.

9. The method according to claim **5** which further comprises defining a target thickness profile including a target value that designates a single target thickness to be achieved over the layer surface for each layer of the batch.

10. The method according to claim **1** which further comprises treating batches of layers, wherein one layer thickness in the batch is adjusted by a certain given pitch while a subsequent layer thickness is being measured.

11. The method according to claim **1** wherein the thickness profile is measured by at least one of an ellipsometer or a reflectometer.

12. The method according to claim **1** wherein the sacrificial oxidation is implemented by utilizing at least one of a thermal oxidation technique or a rapid thermal oxidation technique.

13. The method according to claim **1** which further comprises selectively oxidizing different locations of the layer during sacrificial oxidation.

14. The method according to claim **1** which further comprises selectively powering a plurality of heater lamps situated to face different locations of the layer during sacrificial oxidation to locally adjust the temperature at which the layer is oxidized.

15. The method according to claim **1** wherein the thin semiconductor material layer is an upper layer of a multilayer structure.

16. The method according to claim **15** wherein the upper layer is made of silicon.

17. The method according to claim **15** wherein the multilayer structure is an SOI structure.

18. An apparatus for adjusting the thickness of a thin semiconductor material layer comprising:

means for measuring the layer to establish a thickness profile;

means for determining thickness adjustment specifications from the measured thickness ~~profile; and~~ selective

means for conducting sacrificial oxidation for adjusting the thickness of the layer in accordance with the specifications.

19. The apparatus according to claim **18** further comprising a processor unit operatively associated with the measuring means and the thickness adjustment means.

20. The apparatus according to claim **18** wherein the measuring means, the thickness adjustment means, and the processor unit are integrated in the apparatus.

21. The apparatus according to claim **18** wherein the measuring means is a reflectometer.

22. The apparatus according to claim **18** wherein the thickness adjustment means is suitable for treating the thickness of the entire surface of at least one layer simultaneously in a selective manner.

23. The apparatus according to claim **18** wherein the thickness adjustment means is adapted to adjust the thickness of one layer at a time.

24. The apparatus according to claim **23** wherein the thickness adjustment means is a tube oven.

25. The apparatus according to claim **18** wherein the thickness adjustment means enables the thickness of entire batches of layers to be adjusted at one time.

* * * * *